DOCUMENT RESUME

ED 348 216 SE 052 513

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TITLE	Square One TV: Coding of Segments.
INSTITUTION	Children's Television Workshop, New York, N.Y.
PUB DATE	1 Aug 91
NOTE	23p.; For content analysis of Square One TV programing through the first four years, see SE 052 514.
PUB TYPE	Reports - Evaluative/Feasibility (142)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Coding; *Content Analysis; *Evaluation Methods; *Program Evaluation
IDENTIFIERS	*Square One TV

ABSTRACT

This report describes the system used to code each segment of Square One TV for content analysis of all four seasons of production. The analysis is intended to aid in the assessment of how well Square One is meeting its three goals: (1) to promote positive attitudes toward, and enthusiasm for, mathematics; (2) to encourage the use and application of problem-solving processes; and (3) to present sound mathematical content in an interesting, accessible, and meaningful manner. The information in this report is organized according to these goals and examples are given with their production numbers in parentheses to illustrate the interpretations made in the process of coding the segments for Seasons I-IV. For the coding of goal 1, three positive associations with mathematics are defined: mathematics as a powerful tool, mathematics as aesthetically pleasing, and mathematics as initiated and understood by nonspecialists. For the coding of goal 2, a segment is coded if: a specific problem is stated or formulated, a problem-solving heuristic is stated, or problem treatment is exhibited. For the coding of goal 3, a segment is coded according to its content area. The coding form also includes a short list of other topics for analysis: unanswered questions to the viewer, invitations to participate, calculator and/or computer use, and mistakes made and corrected. Coded segments are entered into a database for easy retrieval. An example of a coding form is provided. (MDH)

SQUARE ONE TV

CODING OF SEGMENTS

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August 1, 1991

This report describes the system used to code each segment of Square One TV for content analysis of all four seasons of production. The analysis is intended to aid in the assessment of how well Square One is meeting its goals, as well as in the preparation of show rundowns. This analysis is complemented by the Analysis of "Mathnet" Scripts prepared by Schneider, Miller, McNeal, and Esty. These "trunk" analyses weight the sophistication of the mathematical problems treated in each "Mathnet" episode, but do not categorize the problems by content area.

Each segment produced is coded on a coding form. This form provides a quick way to check off actions and dialogue that correspond to the three goals of Square One TV. It is important to note that each topic area is coded only once, even when it is mentioned more than once in the segment. Furthermore, the coding gives no indication of the order of occurrence or of the strength of the treatment of these content areas; the goals are listed alphabetically in the database. As the coding system has evolved, the form has changed. A copy of the current form is included at the end of this report. The coding for each segment is then entered into the database, and, finally, used to produce a content analysis report of the complete Square One library. Changes in coding resulting from the evolution of the coding process have been made in the database so that it shows the current assignment of goals.

Once the coding information is entered into the database, segments can be called up according to the goals that they address, the necessary column names and descriptions are given in Square One TV Production Database, a report written by Pierce and Schneider. Brief notes are included on the coding sheets (but not in the database) wherever the appropriateness of a certain goal is unclear.

The information in this report is organized according to the list of goals for Square One TV. Examples are given with their production numbers in parentheses to illustrate the interpretations made in the process of coding the segments from Seasons I-IV.

I. Positive attitudes and enthusiasm

In order to motivate its viewers about mathematics, Square One TV presents segments that model and promote positive attitudes about the subject. For purposes of analysis, three positive associations with mathematics are defined: mathematics as a powerful tool, as something that is aesthetically pleasing, and as a subject that can be developed and understood by nonspecialists. The coding for goal I serves as an indicator of how well the show presents all three of these.

A. Mathematics is a powerful tool

Segments are coded for IA whenever mathematics is explicitly used to solve a concrete, practical problem. That is, it is not coded when mathematical topics are explored for their own sake. "Dirk Niblick: To There and Back" (40041, 40042) is coded for IA because Dirk and friends used math to figure out the most economical delivery plan. Inserts such as "Mathematics, it's a mental tool, use your noggin ... it's supercool" (43040) are coded for goal IA because math is described as a "tool", even if concrete examples are not given.

B. Mathematics is aesthetically pleasing

Segments are coded for IB when a character's response to something mathematical is one of amazement or appreciation; when something mathematical is conceptually or visually beautiful; or when mathematical patterns are shown (these can be visual patterns, e.g., graphics in "The Infinity Song," 10230). "Daddy Knows Different: Stainless Forks" (12990) is coded IB because the father falls over when he hears how much money he will have to pay if he doubles the amount each day. "Person on the Street" segments about large numbers are coded IB when they include explicit verbal responses like, "Wow!" (e.g., 30970).

C. Mathematics is initiated and understood by nonspecialists

A nonspecialist is defined for coding purposes as anyone who is not an expert in mathematics or in a very closely related science (a medical doctor is a nonspecialist according to this definition). The "Mathcourt" episodes show nonspecialists using mathematics. Comments such as "Insert: Dracula 2" in which Dracula says, "I was always good at math in school," are coded for IC because the

individual is making comments in relation to his or her relationship to mathematics. Comments by, say, Julie Brown, that mathematics is a "mental tool" are not considered to indicate anything about her relationship as a nonspecialist to mathematics.

II. Problem solving

The second goal of Square One TV is to model the process of problem solving. Approaches to problem formulation, treatment, heuristics, and follow-up are treated. All phases of this process are coded as problem solving. A segment is coded for goal II if any one of the following is true:

- A specific problem is stated or formulated (coded as IIA-1) without necessarily being solved, for example, in a Monday episode of "Mathnet"; or

- A problem-solving heuristic such as "make a chart" is explicitly stated, for example in "Mathman Math Myths" and "Math-Za-Poppin", without a problem necessarily being solved; or

- Problem treatment is exhibited without necessarily formulating for the viewer a clear problem to be solved. For example, in "Division of: Estimation" (40710), a worker is seen making an approximate measurement and then a calculation although the specific problem she is solving is unclear.

A-1. Recognize or state a problem

When the problem to be solved is specified, then the segment is coded for IIA-1 and "problem solving". The problem statement or re-statement should occur before problem treatment is begun in order to be classified as problem formulation (IIA-1) rather than as recall of information (IIB-1). An example is "Callous: Candy Box" (16700) in which Henry Clayborn explains to Callous' daughter that he was supposed to make a rectangular box that would fit 101 candies in one layer.

A-2. Assess value of solving

This is coded when an explicit statement is made referring to the need to find a solution or to the consequences of failing to solve the problem. For example, Pat might go to jail if the Mathnetters do not solve the "Case of the Calpurnian Kugel Caper" (40071-40075).

A-3. Assess possibility of solving

This is coded when an explicit statement is made about the certainty of finding a solution, or the difficulty of solving the problem. An example is "Dirk Niblick: DT's Map" (40011, 40012) in which DT, Beasley, and Dirk discuss the possibility of coloring all 48 contiguous states using just three colors.

B-1. Recall information presented

Segments are coded for this when the problem data is reiterated as part of the problem treatment, as opposed to situations in which a problem is formulated (IIA-1). In the game shows, restatement (repetition) of the problem by the host for contestants is not coded at all because it has already been coded as IIA-1. In "Mathnet" segments, both "What Do We Know?" and recaps that are introduced by a reference to the explicit intention to review the facts are coded as IIB-1.

B-2. Estimate or approximate

When characters explicitly make an estimate or an approximation as part of the process of solving a problem, the segment is coded for IIB-2. Although there is not much verbal comment in "If It's Out There: Shopper" (43050), it is a good example of IIB-2 in its visual portrayal of a cashier estimating three quarters of a watermelon.

B-3. Gather data, check resources

This is a broad category that encompasses diverse ways in which more data are gathered to solve a problem. It includes consulting an expert, taking measurements, or interviewing suspects.

B-4. Calculate or manipulate geometric (mental or physical)

All calculations in the course of solving a problem are coded as IIB-4, as in "Square One Challenge 1, Question #3" (40223) where the panelists figure the price of popcorn and gum. Manipulation of geometric objects is also coded IIB-4, for example, fitting two triangular pieces over a rectangle to compare areas in "Mathcourt 6: Lawn Area" (40420).

B-5. Consider probabilities

This includes not only the calculation of specific probabilities, but discussion of the general probability of an event as well; for example, describing something, with some justification, as "unlikely" or "highly probable". "Dirk Niblick: Take Two And..." (40061, 40062) is coded for this: Dirk, coaching baseball, uses the records of the team members' previous plays to make predictions about their probability of success.

B-6. Use trial and error; guess and check

This is coded when the method of solution specifically includes the testing of a number of solutions in a systematic manner, not simply a series of mistakes. In "Dirk Niblick: DT's Map" (40011, 40012), DT and Beasley use a "trial and error" approach as they first try to color a map with three crayons, fail, and then try with four and succeed.

C-1. Represent the problem

Goal IIC-1 is coded only for tools used as part of the problem treatment.

a. Scale model, drawing, or map:
These must show scale or measurements. In "Mathcourt 6: Lawn Area" (40420), a scale model of the prosecutor's lawn is used to show that the areas of the triangular piece and the rectangular piece are the same.

b. Picture, diagram, or gadget:
Diagrams are distinguished from scale models in that they represent some aspects of a situation accurately, but not all. These do not show scale; for example, spinners and nets which are then folded up are considered gadgets (a gadget is the three dimensional analog of a diagram), as is the function machine in "Celebrity Kitchen" (14070).

c. Table, chart:
This includes any organization of data in a form where it is available for examination, for example, Superguy uses his super powers to make a chart to convert dollars to droobs in "Superguy: Flying down to Freezo" (13780).

d. Graph:
An example is "Ice Cream Store: Calories" (10130) in which a woman on a diet chooses a frozen treat by using a bar graph showing the number of calories in each.

e. Use objects, act out:
This includes simulations as well as solving the problem directly through physical manipulations, for example, counting out coins to represent fractions as in "Mathcourt 3: Adding Fractions" (40390). In "Bobo's Dilemma" (15410), Bobo the clown uses objects as he tries to find a way to travel 7' to the center of a circus ring using two 6 1/2' boards.

C-2. Transform the problem

a. Reword or clarify:
This is coded for rewording or clarification of the problem (or some part of the problem) that occurs during the problem-solving process. For example, the doctors in "General Mathpital: Asymmetriosis" (40520) redefine symmetry as making one half of the object look like the other half.

b. Simplify:
The reduction of a problem to a simpler case falls under this heading. For example, only the blue bars (showing high temperatures) are needed to read the lowest high temperature off of a two-color bar graph in "Square One Challenge 4A: Question #2" (30183).

c. Find subgoals, work backwards:
This is used to code explicit treatment of a problem in more than one step, but does not include the steps of a calculation. For example, in "Square One Challenge 4, Question #2" (40252), one of the panelists works backwards to find how long before half of a pond is covered by lily pads if the surface area covered doubles every month.

C-3. Look for:

a. Patterns:
The patterns need not be strictly mathematical. In many episodes of "Mathnet", for example, Pat and George look for patterns of thefts, and this is coded as IIC-3a.

b. Missing information:
This applies to situations in which the characters search for particular information that they are missing

and that they think might be relevant to the problem at hand, as in "Spade Parade: Des Moines Duck" (12361, 12362) when Spade asks Ms. Nouveau which of her guests had been wearing gloves and which had been carrying luggage.

c. Distinctions in kinds of information:
This is coded when characters explicitly designate data as relevant or irrelevant to the problem, as in "Mathnet: Missing Monkey" (11031-11035) when George calculates the cost of the stolen bananas and Kate replies, "but I don't think that's a problem we should be working on."

C-4. Reapproach the problem

a. Change point of view, reevaluate assumptions:
For this coding, the characters must act on their reevaluation. For example, in "Elephants in Pens" (15840), two cavemen try to put 11 elephants into pens in odd-numbered groups, and are unable to do so until they decide that one pen may contain another. Assignment of goal IIC-4 does not necessarily imply IIC-4b (new hypothesis), but often does.

b. Generate new hypotheses:
This is used to code any proposal of an hypothesis different from the first, even if it does not involve a reevaluation of the situation (IIC-4a). This includes suggestions starting with "What If...?"

D-1. Discuss reasonableness of results

This includes simple comments about the result or conclusion such as "That makes sense," as well as discussions of precision of results. For example, in "Whither Weather" (13120), the weatherman points out that the security guard's calculation of average snow depth as 0.75" cannot be right because the smallest measurement taken was 1".

D-2. Look for alternative solutions

This is coded when someone has generated a solution and then proceeds to search for an alternative one, for example, "Callous: Candy Box" (16700), in which the characters look for several ways to package 101 candies in rectangular boxes. This also includes any situation in which two valid answers to a problem are illustrated, as when both panelists give valid answers in "Square One Challenge."

D-3. Look for alternative ways to solve

This includes looking for another method of solution after a solution has been reached. For example, the doctors in "General Mathpital: Asymmetriosis" (40520) look for ways to make the patient symmetric with fewer surgical cuts. This search does not always involve reevaluation of the assumptions behind a problem, but when it does, the segment is also coded for "reapproach the problem" (IIC-4a).

D-4. Look for, or extend to, related problems

A segment is coded IID-4 when a generalization is made or suggested. For example, in a "Square One Challenge" question that asks what shape would be gotten when a sphere is sliced (30241), the answer includes the statement that "No matter where you slice it, you'll get a circle."

III. Present sound mathematical content in interesting ways

The third goal of Square One TV is to present a broad range of topics, many of which are not included in the typical elementary school curriculum. Coding takes into consideration only the mathematical tools used or ideas explicitly expressed in a segment, not sophisticated interpretations that they might evoke. Note that no distinctions have been made between levels of importance of these content areas to the segment.

A. Numbers and counting

1. Whole numbers:
   This area is so general that segments are not coded as such in every case involving whole numbers. Instead, this category is reserved for segments which focus on the properties of whole numbers as a set, such as "Infinity - There Is No End" (31110). Another example is the "Amazing Story of Nines" (11351, 11352) in which a genie explains that the sum of the digits of a multiple of nine is also a multiple of nine.

2. Numeration (place value, palindromes, other bases, Roman numerals):
   This is also used for the subject of large numbers (million, billion), as in the song "One Billion is Big" (20850) which describes one billion as one thousand times a million.

3. Rational numbers (interpretations of fractions as numbers, ratios, parts of a whole or of a set):
"Mathcourt 3: Adding Fractions" (40390) fits under this heading because of a discussion of fractions where parts of a whole are compared to parts of a dollar ("half" and "quarter" dollars).

4. Decimal notation (role and meaning of digits in decimal numeration):
An example of this subheading is "General Mathpital: Decimal Point" (40480) in which two surgeons discuss the different meanings of a numeral with different placement of the decimal point.

5. Percents (uses; link to decimals and fractions):
The song "Harry's Hamburger Haven" (14240) compares the fractional, decimal, and percent notations for some specific fractions, and is a good example of IIIA-5. "Piece of the Pie" segments are also coded this way because of the graphics shown in the opening.

6. Negative numbers (uses; relation to subtraction):
"Less Than Zero" (14150) is a song about an athlete who earns negative scores in Olympic-type games.

B. Arithmetic of rational numbers

1. Basic operations (addition, subtraction, division, multiplication, exponentiation; when and how to use operations):
Similar to the coding of goal IIIA-1, a segment is not coded IIIB-1 for every use of the basic operations. Rather it is reserved for segments in which the choice of an operation or a calculation is central. For example, in "Dirk Niblick: DT's Map" (40011, 40012), Dirk demonstrates the commutative property of multiplication to Beasley. Another example is "Thirty-Two Divided by Five-1,2,3" (13331-13333) in which three contexts involving this same division require three different interpretations of the quotient.

2. Structure (primes, factors, and multiples):
Examples of this subheading are the "Perfect Squares" song (13140) which describes square numbers, and all segments of the game show "But Who's Multiplying?".

3. Number theory (modular arithmetic, including parity; Diophantine equations; Fibonacci sequence; Pascal's triangle):
This is used for any kind of numerical sequence, not

just the Fibonacci sequence. For example, "Mathnet: Case of the Unnatural" (40121) is coded for this because of the discussion of sequences in "Guess My Rule". Many of the "Blackstone" segments (e.g., 13441 or 13443) are coded in this way, as is the segment "Odd Pair" in which Felicia tells Oscarina that the sum of two odd numbers is always even.

4. Approximation (rounding; approximate calculation, interpolation, and extrapolation):
   This is used especially for rounding or approximating the number of something, rather than for making a spatial approximation (contrast this with IIIC-3, under "measurement", used for the "Close Call" estimation games). "Wang Spot: Lemonade" (30400) is coded for IIIB-4 because one child rounds $5.97 to "six bucks".

5. Ratios (use of ratios, rates, and proportions; relation to division; golden section):
   In "John Moschitta: Peter Piper S, M, F" (17907), Moschitta's rate of speaking is illustrated in line graphs showing slow, medium, and fast on the same grid.

C. Measurement

1. Units:
   This is coded where knowledge of the size of a unit is critical, not where a unit of measurement is mentioned only in passing. In "Mathnet: Despair in Monterey Bay-5" (40105), for instance, Pat and George realize that 27 fathoms is too great a distance for them to descend underwater.

2. Spatial:
   Area, volume, etc. are coded here even when specific measurements are not used, for example, "Mathcourt 6: Lawn Area" (40420) is coded for this because two triangular pieces are fitted onto a rectangle to show equal areas.

3. Approximate nature of measurement:
   This is used both for segments that show the approximate nature of the measurement process (even measurement devices have margins of error) and for segments that show someone estimating a measurement, with or without tools. For example, a character estimates the height of a tree in terms of his own height in "Division of: Apple Estimation" (40760).

4. Additivity:
   An example is "Daddy Knows Different: Lawn Mowing-1,2" (11191, 11192) in which the son shows his dad how to compute the area of their lawn by dividing it into three rectangles and then summing their separate areas.

D. Numerical Functions and Relations

1. Relations (order, inequalities, subset relations, additivity, infinite sets):
   This is used for explicit inequalities, such as those in some of the "Mathman" episodes or in the "Lightning Round" of "Piece of the Pie". It is also used for questions such as "Which is greater?", because "order" refers to the concept of greater and lesser numbers.

2. Functions (linear, quadratic, exponential; rules, patterns):
   This is used in cases where something (a variable, though not necessarily ever referred to as such) changes according to the way that something else changes. There need not be any mention of a specific equation describing the relationship. An example of this is the discussion of supply and demand found in "Mathnet: The Calpurnian Kugel Caper-2" (40072). This category is used for alphanumeric codes, since they are an example of a system where letter values are assigned to specific numerical values.

3. Equations (solution techniques, e.g., manipulation, guess-and-test; missing addend and factor; relation to construction of numbers):
   The "Wang Spot: Paper Route" (30410) is an example of a segment which is coded this way because it shows the solution of several equations.

4. Formulas (interpretation and evaluation; algebra as generalized arithmetic):
   This is coded for some of the "Mathman" inequality segments where Mathman must find a number satisfying an inequality such as, $x + 3 > 6$, and for "Wang Spot: Paper Route" (30410) where variables are replaced by calculated values.

E. Combinatorics and Counting Techniques

1. Multiplication principle and decomposition:
   The song "Combo Jombo" (21400) is coded for this. It describes how to figure, say, the number of different

quartets that can be made from two drummers, two sax players, and three guitar players.

2. Pigeonhole principle:
   "Square One Challenge 8: Question #3" (40353) asks how many socks must be pulled from a drawer of black and brown socks in order to guarantee a pair.

3. Systematic enumeration of cases:
   This category is used primarily to code segments involving logic problems. For example, Spade Parade makes a series of deductions to figure which of three men is telling the truth in "In Search of Yucca Puck" (15901).

F. Statistics and Probability

1. Basic quantification (counting; representation by rational numbers):
   In "Grempod & Blotmo: Sponge Candy" (14420), aliens with four hands instead of two try to choose the hand holding the sea fig, thus illustrating the expression of probabilities as ratios.

2. Derived measures (average, median, range):
   "Whither Weather" (13120) treats the concept of an average with a discussion of a bar graph of the depth of snow found in six places on a rooftop.

3. Concepts (independence, correlation; "Law of Averages", etc.):
   This list of concepts is not all-inclusive. For instance, the discussion of random number generators with replacement or nonreplacement systems in "Mathnet: The Calpurnian Kugel Caper-1,2" (40071, 40072) is coded under this subheading.

4. Prediction (relation to probability):
   The voice-overs in Season III episodes of "But Who's Counting?" (e.g., 30520) point out the probability of a given number turning up on the wheel, and in "Mathnet: Swami Scam-3" (30013) the probabilities of a given prediction coming true are discussed.

5. Data collection and analysis:
   This refers to situations in which someone performs a simulation or experiment and/or analyzes data that have been collected (by making calculations on the data, making a chart, making qualitative analyses, etc.). For example, in "Mathnet: Despair in Monterey Bay-4" (40104), George and Pat chart the times

various objects took to fall through 10 feet of water.

6. Data presentation and interpretation (graphs, charts, tables; construction and interpretation):
   This is coded for use or discussion of graphs, charts, or tables, whether the characters are in the process of deciding how to present the data in one of these forms, making the chart, or interpreting a chart that has already been made. This subcategory often overlaps IIIF-5 (data collection and analysis), but must include some sort of graph, chart, or table. For example, the Mathnecters examine insurance policy data from charts, graphs, and tables in "Mathnet: Purloined Policies" (40082).

G. Geometry

1. Dimensionality (one, two, three, and four dimensions):
   Segments coded for IIIG-1 include "Math-Za-Poppin' #2" (30730) which presents an interview with Descartes, and "Me and My Shadow" (13660) in which a dancer explains differences between two and three dimensions to her shadow.

2. Rigid transformations (transformations in two and three dimensions; rotations, reflections, and translations; symmetry):
   "Square One Challenge" questions about aligning two boxes so that the triangles painted on them match exactly (40231) and about predicting the shape produced by cutting an "F" into a paper folded four times (40221) illustrate IIIG-2. Another example is seen in "Mathcourt 6: Lawn Area" (40420) where two triangular pieces of cardboard are laid on top of a rectangular piece to prove their areas are the same.

3. Tessellations (covering the plane and bounded regions; kaleidoscopes; role of symmetry; other surfaces):
   The "Tessellation Song" (15810) which illustrates many different tessellations is a good example of this subheading.

4. Maps and models in scale (application of ratios):
   "The Map" (14050) shows a boy not only reading a map, but using the scale to calculate the length of a car trip.

5. Perspective (rudiments of drawing in perspective; representation of three-dimensional objects in two dimensions):
   In "Mathnet: The Map with a Gap-1" (20001) a map is read in the reflection of a cylindrical mirror.

6. Geometrical objects, constructions, patterns (recognition; relations among; constructions; patterns):
   This subheading covers a wide range of material. Some examples of segments coded as IIIG-6 are: "An Interesting Game of Football" (14370) for its story involving a trapezoidal football field, "Mathnet: Ersatz Earthquake-2" (30002) for its treatment of trilateration, "Angle Dance" (10180) for the discussion of angles, and all games of "Triple Play," which require the recognition of equilateral triangles.

7. Topological mappings and properties (invariants):
   This topic occurs rarely. An example is "Moebius Trip" (10700), an animation in which a car is seen driving along a highway built like a Moebius strip.

The coding form also includes a short list of other topics for analysis: unanswered questions to the viewer, invitations to participate, calculator and/or computer use, and mistakes made and corrected. Just as in the coding of other categories, evidence of these must be explicit. Finally, each segment is given a flag if it is considered to involve problem solving.

- unanswered questions to the viewer

  This must be an explicit question that is posed to the viewer and not answered during the segment. If there are intervening segments, it can be a question posed in part 1 of, say, a "Dirk Niblick" which is answered in part 2. If the person speaking does not address the viewer specifically, but wonders aloud about a mathematical question, this is also considered an "unanswered question to the viewer". "Mathnet: Despair in Monterey Bay-1" (40101), where George asks, "I wonder how hard the wind has to blow to change the angle of the rain this much?", is an example of this. Note that an "unanswered question" implies an "invitation to participate".

- invitation to participate

  This must be an explicit invitation. Even segments that are conducive to viewer participation by their very nature, such as "Close Call" or "Mathman," are not coded for this

without an explicit invitation. "Check this out" is not considered an invitation to participate, only to view. An example that does qualify is "get pencil and paper" in "But Who's Counting?"

- calculator use

This refers to instances when it is clear that a character is using a calculator, even if the viewer does not know the problem motivating the calculator use. "Division Of: Estimation" (40710) is an example of this, since the contractor is shown using a calculator as she estimates.

- computer use

Just as with the calculator, this is noted when someone uses a computer, whether or not the reasons for use are apparent. "Dirk Niblick: Golden Years" (40021, 40022), for example, is coded for this because it opens with Dirk using his home computer, even though his particular use for it is not referred to in the episode.

- mistakes made and corrected

This is coded when individuals model good reactions to a mistake that one of them made (not just any time a mistake is made). An example of this occurs in "Cosmic Carpets" (11980) in which an earthling points out that two aliens have incorrectly computed the area of a region by dividing it into overlapping rectangles. This category is also coded when people are talking about a past mistake and how they dealt with it, as when Pat and George describe their incorrect dive locations in "Mathnet: Despair in Monterey Bay-5" (40105).

- problem solving

A necessary condition for a segment to be considered "problem solving" is that it explicitly exhibit one of the stages of problem solving: formulation, treatment, and follow-up. If a problem is introduced but not worked on during the segment, the segment is coded as problem solving because it models problem formulation. Examples of this are frequently found in Monday episodes of "Mathnet" that set a problem, but end before the Mathnetters begin its treatment. "Problem solving" is also used for a description of problem solving actions that actually occurred prior to the time of discussion, as in episodes of "Mathcourt".

Some of the goals are directly linked, and these were used to check the coding. For problem solving segments, some goal III categories should imply that corresponding goal II categories be coded:

- Coding of a segment for goal IIIB-4 (rounding) implies that the segment should also be coded for goal IIB-2 (make estimates).

- Coding for goal IIIC-3 (estimation in measurement) implies coding for goal IIB-2 (take measurements, estimate).

- Coding for goal IIIF-4 (prediction related to probability) implies that a segment should be coded for goal IIB-5 (consider probabilities).

- Coding for goal IIIG-4 (maps) implies coding for goal IIC-1a (use of maps, scale models).

In many cases, segments coded for IIB-2 (make estimates or take measurements), are also coded for IIIB-4 (rounding) or IIIC-3 (approximate nature of measurement). Similarly, segments coded for IIC-1a (represent the problem: scale model, drawing, map) were checked to see if they should also be coded as IIIG-4 (maps and models in scale). Many segments coded for probability with regard to prediction, IIIF-4, are also coded for IIIF-1, probability expressed as a ratio.

Finally, a question to the viewer implies an invitation to participate, and a segment is coded as "problem solving" if and only if some categories of goal II are coded as well.

"Mathnet" and some game shows recur over all four seasons. Some notes are given below about how they are coded.

A. General Notes

All game shows with child participants are coded IC for their demonstration that mathematics can be developed, understood and used by nonspecialists.

All game shows are considered to be problem solving.

Each game show explicitly states a problem, IIA-1.

B. "Square One Challenge"

The "Square One Challenge" segments are unlike any of the others in that three distinct and unrelated problems are presented. As one of our aims is to present problems

covering many content areas, coding the game as a whole would overcount the number of segments involving two or more distinct categories of goal III. Each question is therefore coded on a separate coding form and is given its own production number. The game itself is not coded. The last digit of the production number of each question is a 1, 2, or 3, depending on its order in the context of a particular game. For example, the production number for "Square One Challenge 3" in Season IV was 40240, so the second question of "Square One Challenge 3" is labeled 40242.

All "Square One Challenge" games are coded for IC (understood by nonspecialists), problem solving, and IIA-1 (state a problem).

The problem-solving approaches (goal II) coded for problem treatment, representation, and follow-up are those explained in the cast members' justifications, not assumptions about the approach that a child contestant might take.

Goal IIC-2a (reword or clarify) is coded if and only if the rewording is done by the cast members who are solving the problem (the host rewords a statement before the problem-solving process begins, so his instruction is not considered part of any heuristic).

When both cast members supply correct answers, the segment is coded for IID-2 (look for alternative solutions). Segments in which the host mentions the possibility of an additional solution after the cast members' answers are revealed are also considered to exhibit IID-2.

An extension of a problem, suggested by the host when he says something like, "Our viewers might want to think about ..." is an example of IID-4 (look for, or extend to, related problems). Such comments are also considered to be both "unanswered questions to the viewer" and "invitations to participate".

The betting round (question #3 in Season IV games) is not automatically coded for IIIF-4 (prediction with relation to probabilities), since it is not known whether the child contestants considered probabilities in making their betting decisions.

Since the Venn diagrams that are used as scoreboards behind the contestants are not specifically mentioned, they are not coded as IIIF-6 (data presentation and interpretation).

C. "Piece of the Pie"

These segments are all coded for IA (mathematics as a powerful tool) and IC (mathematics is understood and used by nonspecialists). Although the problem to be solved by the contestants is not really a mathematical one, the segments are coded as problem solving because of the problem-solving heuristics that are used: IIA-1 (state a problem), IIB-6 (guess and check) and IIC-3b (look for missing information). They are not coded for IIC-1 (represent the problem), because the contestants do not explicitly use a graph.

All "Piece of the Pie" segments address goals IIIA-5 (percents), IIIB-1 (basic operations), IIID-1 (inequalities) for the comparison of the contestant's score to the target score in the "Lightning Round", and IIIF-6 (data presentation).

When the unguessed possibilities are discussed at the end of a game, the segment is coded for IID-2, look for an alternative solution.

When the contestants call a huddle, the segment is coded for IIB-3 (gather data, check resources).

D. "Close Call"

Unlike "Square One Challenge" questions, the three tasks in each game are coded on a single coding form as they all address the same content areas.

These segments are all coded as addressing goal IC (nonspecialists initiate, develop, and understand mathematics), problem solving, IIA-1 (state a problem), IIB-2 (estimate), IID-1 (discuss reasonableness and precision of results), and IIIC-3 (approximate nature of measurement). Goal IIC-1 (represent the problem) is not coded because the props used are considered to be a central part of problem formulation, not methods for approaching a solution.

Segments are coded as IIIC-1 (units of measurement), IIIC-2 (spatial measurements), and IIIG-4 (maps and models in scale), depending on the tasks. For example, IIIG-4 is used when specific measurements are given and the prop that is used is a scale representation of something.

The segments are coded for "invitation to participate" only if voice-over announcements contain an explicit invitation to the viewer.

E. "Mathnet"

The goals coded for each episode of "Mathnet" are noted in the margins of the scripts for reference.

The recurring heuristics of "What Do We know" and "What If" are coded as IIB-1 (recall information) and IIC-4b (generate new hypotheses), respectively.

Goal IIA-1 is coded each time a problem is stated, whether or not it is considered to be the main problem that the Mathnetters are solving. Distinctions between the primary problem and subsidiary or tangential ones are made in the trunk analyses found in Analysis of "Mathnet" Scripts. If a problem is restated in successive episodes, it is coded again for those segments.

Other Notes:

All "Phoners" are coded as IC for their presentation of nonspecialists who initiate and understand mathematics.

All nets are coded as IIIG-5 (representation of 3-dimensional objects in 2 dimensions), IIIG-6 (geometric objects), but not IIIG-2 (rigid transformations).

All occurrences of triangulation are coded as IIIG-6 (geometric constructions -- relations among geometric objects), not IIIG-5 (perspective).

Segments about large numbers are coded as IIIA-2 (numeration -- place value).

All occurrences of alphanumeric codes and sequences are coded as IIID-2 (functions -- patterns). Sequences are also coded as IIIB-3 (number theory -- sequences).

Production information for promotions and specials is entered into the database, but are not coded.

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CONTENT ANALYSIS

GOAL I

I. Positive Attitudes and Enthusiasm:

__ A. Powerful and Applicable Tool

__ B. Beautiful Aesthetically Pleasing Subject

__ C. Initiated, Developed, and Understood by Non-Specialist

OTHER ANALYSIS

__ Unanswered questions to viewer
__ Invitation to participate
__ Calculator use
__ Computer use
__ Mistakes made and corrected

PROBSOLV

NOT PROBSOLV

GOAL III

____. ____. ____
____. ____. ____ Mathematics Content

ACTION

A. PROBLEM FORMULATION

__1. Recognize a problem; State a problem
__2. Assess value of solving
__3. Assess possibility of solving

B. PROBLEM TREATMENT

__1. Recall information presented
__2. Estimate or approximate
__3. Make measurements; Gather data; Check resources
__4. Calculate, or Manipulate geometric (Mental or Physical)
__5. Consider probabilities
__6. Use trial and error; Guess and check

D. PROBLEM FOLLOW-UP

__1. Discuss reasonableness of results (and precision of results)
__2. Look for alternative solutions
__3. Look for alternative ways to solve
__4. Look for, or extend to, related problems

HEURISTICS

C1. REPRESENT PROBLEM
__a. Scale model, drawing, map
__b. Picture; Diagram, gadget
__c. Table; Chart
__d. Graph
__e. Use objects; Act out

C2. TRANSFORM PROBLEM
__a. Reword, clarify
__b. Simplify
__c. Find subgoals, sub-problems (work backwards)

C3. LOOK FOR
__a. Patterns
__b. Missing info
__c. Distinctions in kinds of information-pertinent, extraneous

C4. REAPPROACH PROBLEM
__a. Change point of view; Reevaluate assumptions
__b. Generate new hypotheses

Date: _____ Prob. #: _____

Coder _____ Title _____